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Status Assessment of Toxic Chemicals

Tris(2,3-Dibromo-propyl) Phosphate

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16. ABSTRACT

The properties, production processes, and uses of tris (2,3-Dibromopropyl) phosphate (otherwise known as "tris") are listed. Current control technology is discussed along with potential sources of environmental contamination by tris. Possible effects on children already exposed to tris are indicated, a history of the regulation of tris is given, and areas in which information is lacking are identified.

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STATUS ASSESSMENT OF TOXIC CHEMICALS:
TRIS(2,3-Dibromopropyl) PHOSPHATE

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FOREWORD

When energy and material resources are extracted, processed, converted, and used, the related pollutional impacts on our environment and even on our health often require that new and increasingly more efficient pollution control methods be used The Industrial Environmental Research Laboratory - Cincinnati (IERL-Ci) assists in developing and demonstrating new and improved methodologies that will meet these needs both efficiently and economically.

This report contains a status assessment of the air emissions, water pollution, health effects, and environmental significance of lead. This study was conducted to provide a better understanding of the distribution and characteristics of this pollutant. Further information on this subject may be obtained from the Organic Chemicals and Products Branch, Industrial Pollution Control Division.

Status assessment reports are used by IERL-Ci to communicate the readily available information on selected substances to government, industry, and persons having specific needs and interests. These reports are based primarily on data from open literature sources, including government reports. They are indicative rather than exhaustive.

David G. Stephan
Director
Industrial Environmental Research Laboratory
Cincinnati

ABSTRACT

Tris(2,3-dibromopropyl) phosphate (tris), one of six commercially significant haloalkyl phosphate compounds produced in the United States, has been used as a flame retardant additive in a variety of products, including cellulose acetate and polyester fibers. Until a recent ban by the Consumer Product Safety Commission (CPSC), tris was extensively used in material for children's wearing apparel. Very few data are available on post-ban uses of tris, both in type of use and in quantity used.

Tris may be produced by addition of bromine to triallyl phosphate or by esterification of phosphorus oxychloride with 2,3-dibromopropanol. Companies manufacturing tris prior to the CPSC ban included Great Lakes Chemical Corporation, Velsicol Chemical Corporation, and White Chemical Corporation; however, the latter no longer produces tris. Production after the CPSC ban has not been quantified. Estimated consumption in 1975 was 4,080 metric tons to 5,400 metric tons.

Little or no research has been performed to determine the environmental fate and reactivity of tris. Reactions and reaction pathways in the environment have not been discovered or proposed, and environmental levels have not been reported. Little information is available regarding atmospheric losses during production, but relatively low losses are expected. Tris could potentially reach the environment from waste streams generated in plants where it is added to fabrics and plastics, or from the final product during its use, disposal and recycling.

Although tris has been shown to be an animal carcinogen, no conclusive data regarding carcinogenicity and mutagenicity to humans are available. A large population may be affected by production and use of fibers and polymers containing tris. Predicted incidences of cancer in children are as high as 17,000 cases/million from 1 yr of exposure to tris-treated garments.

While condensation and absorption generally appear to be the best methods of reducing atmospheric emissions from tris manufacture, information concerning actual techniques is unavailable. A series of treatment steps for wastewater, such as filtration, chemical precipitation and flocculation/filtration, and reverse osmosis, appear to be required.

On April 8, 1977, the CPSC banned certain children's wearing apparel and certain uncut fabric containing tris. Pursuant to an order of a Federal district court judge, the CPSC consequently banned not only certain fabric, yarn, and fiber containing tris, but tris itself which is used in or intended for use in children's wearing apparel.

Information is needed concerning the actual amount of tris presently produced; however, in view of its demonstrated toxicity and its ban from children's garments, this may be insignificant. Initial efforts should be made to catalog the uses of tris by company, usage category, and quantity produced. Production processes and sites should be studied for environmental effects and significance, and information on emissions and effluents from its synthesis and applications, as well as on control technologies should be obtained. A ban on other uses may be indicated. Studies should be coordinated with the CPSC to avoid duplication of effort and to coordinate regulatory action.

This report was submitted in partial fulfillment of Contract 68-03-2550 by Monsanto Research Corporation under the sponsorship of tne U.S. Environmental Protection Agency. This report covers the period November 1, 1977 to December 31, 1977. The work was completed as of January 20, 1978.

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CONVERSION FACTORS AND METRIC PREFIXES[a]

CONVERSION FACTORS

To convert from	To	Multiply by
Degree Celsius (°C)	Degree Fahrenheit	$t_f^\circ = 1.8\ t_C^\circ = +32$
Gram/second (g/s)	Pound/hr	7.937
Kilogram (kg)	Pound-mass (avoirdupois)	2.205
Meter^2 (m^2)	Foot^2	1.076×10^1
Meter^3 (m^3)	Gallon (U.S. liquid)	2.642×10^2
Meter^3 (m^3)	Inch	6.102×10^4
Metric ton	Pound-mass	2.205×10^3
Pascal (Pa)	Pound-force/inch^2 (psi)	1.450×10^{-4}

METRIC PREFIXES

Prefix	Symbol	Multiplication factor	Example
Kilo	k	10^{-3}	1 mg = 1 x 10^{-3} gram
Milli	m	10^3	1 kPa = 1 x 10^3 pascals

[a] Standard for Metric Practice. ANSI/ASTM Designation: E 380-76$^\epsilon$, IEEE Std 268-1976, American Society for Testing and Materials, Philadelphia, Pennsylvania, February 1976. 37 pp.

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SECTION 1

INTRODUCTION

Tris(2,3-dibromopropyl) phosphate (tris) has been used as a flame retardant additive in acrylics, cellulose acetate, cellulose nitrate, phenolics, polyester, polystyrene, polyvinyl acetate, polyvinyl chloride, flexible urethane foam, paints, paper coatings, rubber, and textile coatings. Tris, which is potentially absorbed through the skin, has been shown to be an animal carcinogen in two species and a mutagen to certain bacteria and *Drosophila*. Due to its potential carcinogenicity, concern over potential adverse health effects to the general population from tris exposure has been expressed.

There is a need to define the various sources from which tris may enter the environment, to establish the subsequent health and environmental effects, and to examine possible control strategies and present regulatory actions. This report provides a brief overview describing these items along with a description of tris.

SECTION 2

SUMMARY

Tris, one of six commercially significant haloalkyl phosphate compounds, is primarily used as a fire retardant additive for cellulose acetate and polyester fibers. Until a recent ban by the Consumer Product Safety Commission (CPSC), tris was extensively used in material for children's wearing apparel.

Companies producing tris include Great Lakes Chemical Corp. and Velsicol Chemical Corp. White Chemical Corp. used to produce tris prior to the CPSC ban. The compound may be produced by the addition of bromine to triallyl phosphate or by the esterification reaction of phosphorus oxychloride with 2,3-dibromopropanol.

Estimated consumption of tris in 1975 was 4,080 metric tons[a] to 5,440 metric tons. Use of tris in children's wearing apparel was banned by the CPSC on April 8, 1977. The full extent of using tris in other applications is unknown.

No specific monitoring data or other information is available regarding losses of haloalkyl phosphates from production, but relatively low losses are expected. Table 1 summarizes highlighted information regarding tris. These esters are produced in batch kettles, and since their vapor pressures are low, atmospheric emissions are expected to be insignificant. Industrial sources suggest that no solid or liquid organic wastes are produced. Aqueous wastes could be produced from washing reaction kettles and equipment or from workup. Tris could potentially reach the environment from waste streams generated in plants where it is added to fabrics and plastics or from the final product during its use, disposal, and recycling. Potential transport to the environment could occur by atmospheric emissions, leaching, or with movement of small pieces of treated fabrics or plastic products.

Tris has been shown to be an animal carcinogen. Conclusive data for human exposure have not been established. Since cancers develop over many years and cannot usually be linked to particular cases, this is not unexpected.

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[a] 1 metric ton equals 10^6 grams; conversion factors and metric system prefixes are presented in the prefatory material.

TABLE 1. TRIS(2,3-DIBROMOPROPYL) PHOSPHATE

Emission source	Extent of problem: Emission quantity	Extent of problem: Population exposed	Control method	Regulatory action
Production:				
Great Lakes Chemical Corp., El Dorado, AK Velsicol Chemical Corp. El Dorado, AK	Atmospheric emissions are expected to be insignificant. No solid or organic wastes are reported by producers. Aqueous wastes from equipment cleanup. Transport and storage losses probably negligible.	Unknown.	Information not available. Condensation and absorption appear to be best for atmospheric emissions. Adsorbents other than carbon possibly applicable. Aqueous wastes require a series of steps such as filtration, chemical precipitation, flocculation/filtration, and reverse osmosis. Fugitive emission control through improved operation and maintenance procedures.	Unknown.
Use:				
Estimated 1975 consumption equaled 4,080 metric tons to 5,440 metric tons.	Washing fabric treated with tris could result in leaching into wash water. Possible ingestion of tris by children putting treated sleepwear in mouths.	Estimates include:[a] •17,000 cases/million for children with 1-yr exposure to garments; •6,000 cases/million male population; •25 to 5,100 cases/million males.	Use alternate fire-retardant material.	Consumer Product Safety Commission on April 8, 1977, banned certain childrens' wearing apparel containing tris. The CPSC later banned certain fabric, yarn, and fiber containing tris as well as tris itself.

[a] Expressed as cases of cancer per million exposed. Several assumptions were made in arriving at this estimate.

Information on actual techniques used to control emissions of tris during production is unavailable. Condensation and absorption generally appear to be the best methods for reducing atmospheric emissions from production. Incineration and flaring would produce acid contaminants, and carbon adsorption is most desirable for nonpolar compounds. Adsorbents other than carbon may have some application potential.

Liquid wastes require a series of treatment steps. A typical sequence might include filtration, chemical precipitation and flocculation/filtration, and reverse osmosis. Biological treatment may also be applicable. Applicable technologies depend on wastewaters composition.

In assessing the risk from tris-treated apparel, the CPSC considered cancer incidence projections from three studies. First it was estimated that for 1 yr of exposure to tris-treated garments, 1.7% of the children would develop cancer (17,000 cases/million). Second, the Environmental Defense Funds predicted incidences as high as 6,000/million male population. Third, the CPSC's own estimate ranged from 25 to 5,100 cases/million males.

On April 8, 1977, the CPSC banned certain children's wearing apparel and certain uncut fabric containing tris. Pursuant to an order of a Federal district court judge, the CPSC consequently banned not only certain fabric, yarn, and fiber containing tris, but tris itself which is used in or intended for use in children's wearing apparel. The CPSC is preparing an environmental impact statement of the tris ban and may be studying the appropriateness of a ban on other uses of tris.

Based on the information presented in this report, the following items need to be considered in future studies:

- present production should be quantified; however, in view of its ban from children's garments, this may be insignificant.
- efforts should initially be made to catalog the uses of tris by company, usage category, and quantity produced.
- production processes and sites should be studied for environmental effects and significance.
- information concerning control technology should be obtained.
- production and uses of other haloalkyl phosphates should be determined; if significant, toxicity tests should be conducted to determine similarity to tris.

SECTION 3

SOURCE DESCRIPTION

Tris(2,3-dibromopropyl) phosphate (tris) is one of the six haloalkyl phosphate compounds produced in significant commercial quantities in the United States. Tris and three other tris (haloalkyl) phosphate compounds, DBPP[tris(2,3-dibromopropyl) phosphate]; CEP[tris(2-chloroethyl)phosphate]; CPP[tris(2-chloropropyl)phosphate]; and DCPP[tris(1,3-dichloroisopropyl)phosphate]; are used as fire retardants and are added to products which must meet Federal or state fire retardancy standards (1). The major application of tris is a fire retardant additive for cellulose acetate and polyester fibers. Until a recent ban by the CPSC, tris was extensively used in material for children's sleepwear.

PHYSICAL AND CHEMICAL PROPERTIES

Commercially-available haloalkyl phosphate fire retardants are characterized as essentially odorless liquids ranging in color from colorless to pale yellow. All the commercially significant tris(haloalkyl) phosphate compounds are viscous liquids at ambient temperatures, although, sometimes, the temperature must be increased to permit their pumping in conventional manufacturing technology (1).

General physical properties of tris are summarized in Table 2 (1).

PRODUCTION

Companies producing tris prior to the CPSC ban included Great Lakes Chemical Corp., Velsicol Chemical Corp., and White Chemical Corp. (2). White Chemical Corp. no longer produces tris. Velsicol produces tris but refuses to release any information regarding their production process (personal communication with Fred Lavinn, Velsicol Chemical Corp., August 5, 1977). Great

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(1) Lande, S. S., J. Santodonato, P. H. Howard, D. Greninger, and D. H. Christopher. Investigation of Selected Potential Environmental Contaminants: Haloalkyl Phosphates. EPA-560/2-76-007 (PB 257 910), U.S. Environmental Protection Agency, Washington, D.C., August 1976. 209 pp.

(2) 1977 Directory of Chemical Producers. Stanford Research Institute, Menlo Park, California, 1977. 1059 pp.

TABLE 2. SELECTED PHYSICAL PROPERTIES OF TRIS

Empirical formula	$C_9H_{15}Br_6O_4P$
Molecular weight	697.7
Weight percentage: bromine	68.7
Weight percentage: phosphorus	4.4
Freezing point, °C	5.5
Pour point, °C	-1.16
Viscosity, Pa-s (25°C)	9.2
Vapor pressure, Pa:	
25°C	2.59×10^{-2}
45°C	1.60×10^{-1}
65°C	6.40×10^{-1}
Density, metric tons/m^3 (25°C)	2.27
Physical description of the commercial material at ambient temperature	Pale yellow to light yellow, viscous liquid.
Odor of commercial product	None.

Lakes Chemical Corp. refused to acknowledge when asked if they produce tris (personal communication with Carl, Great Lakes Chemical Corp. on August 5, 1977). The tris manufacturing operations of both Great Lakes and Velsicol are located in El Dorado, Arkansas. Production details for each manufacturer (including capacities and process descriptions) are unavailable.

PROCESS DESCRIPTION

Tris(2,3-dibromopropyl) phosphate may be manufactured by the addition of bromine to triallyl phosphate or by the esterification reaction of phosphorous oxychloride with 2,3-dibromopropanol (3).

In the production of phosphate esters by esterification, phosphorous oxychloride is condensed with the alcohol reactant. The reaction for tris, which usually requires a catalyst, may be written as

$$3CH_2BrCHBrCH_2OH + POCl_3 \rightarrow (CH_2BrCHBrCH_2O)_3PO + 3HCl \quad (1)$$

2,3-Dibromopropanol — Phosphorous oxychloride — Tris — Hydrochloric acid

(3) Chemical and Process Technology Encyclopedia. D. M. Considine, ed. McGraw-Hill Book Co., New York, New York, 1974. 183 pp.

Hydrogen chloride is removed by a current of air or neutralized by the addition of alkali. Glass-lined or alloy kettles are used because the reaction mixture is highly corrosive. In the similar esterification reactions of cresols, product purification is achieved by flash distillation of the reaction mixture and washing with dilute caustic. The dilute caustic neutralizes residual hydrogen chloride and extracts unreacted alcohol and partial esterification products. Further purification steps include caustic washing, steam stripping, permanganate treatment, dehydration under reduced pressure, bleaching with activated carbon, and filtration (4).

Process details were not found in the literature for the production of tris by reacting bromine with triallyl phosphate.

USES

Tris has been used as a flame retardant additive in acrylics, cellulose acetate, cellulose nitrate, phenolics, polyesters, polystyrene, polyvinyl acetate, polyvinyl chloride, flexible urethane foam, intumescent paints, paper coatings, rubber, and textile coatings (5). The synthetic fiber and polymer (plastics and resins) industries include numerous manufacturing facilities which could employ tris in production operations. Flame retardants are added in final mixing steps of polymer production processes or during fiber spinning processes.

Estimated 1975 consumption of tris was 4,080 metric tons to 5,440 metric tons (1). Use of tris in children's wearing apparel was first banned by the CPSC on April 8, 1977 (6). The CPSC compiled a partial list of other tris applications during its investigation of tris manufacturers in preparation for the April 8 ban (personal communication with Bob Poth, Compliance, Consumer Product Safety Division, August 5, 1977). However, the full extent of using tris in other applications is unknown. There are indications that this has been used extensively in the manufacture of cellulose insulation. Due to the rising cost of energy, it is being installed in many northern U.S. homes.

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(4) Thompson, C. M. Industrial Process Profiles for Environmental Use, Chapter 13: Plasticizers Industry. Radian Corporation, for U.S. Environmental Protection Agency, Cincinnati, Ohio, February 1977.

(5) Modern Plastics Encyclopedia, Volume 15, No. 10A. October 1974.

(6) Tris and Fabric, Yarn, or Fiber Containing Tris; Additional Interpretations as Banned Hazardous Substances. Federal Register 42(105):28060-28064. 1977.

SECTION 4

ENVIRONMENTAL SIGNIFICANCE AND HEALTH EFFECTS

ENVIRONMENTAL SIGNIFICANCE

No specific monitoring data or other information are available regarding losses of haloalkyl phosphates from production, but relatively low losses are expected. These esters are produced in batch kettles, and since their vapor pressures are low, atmospheric emissions are expected to be insignificant. Industrial sources suggest that no solid or liquid organic wastes are produced. Aqueous wastes could be produced from washing of reaction kettles and equipment cleanup (1).

Transport and storage losses are probably negligible. Fire retardants are transported in bulk carriers or sealed metal containers. All haloalkyl phosphates are usually stored in sealed containers. Since their vapor pressures are quite low, venting losses should be virtually nonexistent. Accidental spills and mishandling of haloalkyl phosphates may result in some losses; however, no specific information is available on such losses.

Tris could potentially reach the environment from waste streams generated in plants where tris is added to fabrics and plastics or from the final product during its use, disposal, and recycling. Potential transport to the environment could occur by atmospheric emissions, leaching, or small pieces of treated fabrics or plastic products.

Experimental laundering of treated fabric demonstrated that tris can be leached into wash and rinse waters. In a 1975 study, tris surface concentrations on dacron polyester and cellulose acetate were measured during the course of 50 launderings. Tris was spun into the cellulose acetate and topically applied to the polyester. Results indicated that approximately 12% of the tris was lost from the polyester and that most of this loss apparently occured in the first three washings. Results also indicated that a negligible amount of tris was lost from the cellulose acetate. Another 1975 study estimated that in a typical home laundering of six sheets of specified size in 0.11 m^3 of water, a concentration of 6 parts per million (ppm) of tris would be released in the combined rinse and wash.

HEALTH EFFECTS

Effects on Animals

Under the National Cancer Institute's carcinogen bioassay program, which was begun early in 1974, rats and mice were fed tris daily at two dose levels and compared to control animals which were fed no tris. Rats were placed on diets containing 50 ppm (low dose) and 100 ppm (high dose) tris; mice were placed on diets containing 500 ppm (low dose) and 1000 ppm (high dose) tris. The test mice developed tumors in the liver, kidney, lung, and stomach; and the test rats developed tumors in the kidneys. Thus, tris was established as an animal carcinogen (6).

In subchronic toxicity and dermal penetration studies performed by the Consumer Product Safety Commission's Bureau of Biomedical Science, rats receiving daily oral dose of 25 mg/kg and 250 mg/kg developed renal nephrosis following a 13-wk period. Rabbits receiving a weekly dermal application of 10^{-6} m^3/kg of undiluted tris developed renal nephrosis and testicular atrophy at the end of a 13-wk period (6). In one study, the hydrolysis product of tris, 2,3-dibromopropanol, was detected in the urine of a rat following dermal application of tris, thus indicating that tris may be absorbed through the skin. No dibromopropanol was detected in the urine of a rat treated with a fabric containing tris (7). Testing by the CPSC's Bureau of Biomedical Science showed penetration of tris through the skins of rabbits after dermal application of undiluted tris and of tris-treated cloth (6).

A study by Prival, McCoy, Gutter, and Rosenkranz found tris to be mutagenic to histidine-requiring strains of *Salmonella typhimurium*. Fabrics treated with tris were also found to be mutagenic to the same bacteria strains (8). Tests conducted by the CPSC's Bureau of Biomedical Science reported no chromosome aberrations in bone marrow chromosomes of rats which received a single or multiple dose of tris 5d/wk for 13-wk (6). In a letter to the CPSC, Hooper and Ames reported that tris is a potent mutagen in *Drosophila*, causing large numbers of recessive lethal mutations in offspring.

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(7) St. John, L. E., M. E. Eldefrawi, and D. J. List. Studies of Possible Absorption of Flame Retardant from Treated Fabrics Worn by Rats and Humans. Bulletin of Environmental Contamination and Toxicology. 15(2), 1976.

(8) Prival, M. J., E. C. McCoy, B. Gutter, and H. S. Rosenkranz. Tris(2,3-dibromopropyl) Phosphate Mutagenicity of a Widely Used Flame Retardant. Science, 195(4273):76-78, 1977.

The National Institute for Occupational Safety and Health (NIOSH) reports the lowest lethal dose of tris for mice to be 300 mg/kg (direct injection of tris into the peritoneal cavity). The lethal dose for 50% of a test group of rats (oral doses) is reported to be 1,010 mg/kg (9).

Effects on Man

No conclusive data exist establishing that tris has caused cancer in humans. Since cancers develop over many years and cannot be easily linked to particular cases, this is not unexpected. In banning tris from use in children's wearing apparel, the CPSC considered the June 2, 1976 National Cancer Advisory Board opinion that

> "Demonstration that a compound is carcinogenic in animals should be considered evidence that it is likely to be carcinogenic in humans, unless there is strong evidence in humans to the contrary (6).
>
> "Liquid tris caused delayed hypersensitivity in human subject maximization tests. It showed a dose/response relationship and is judged a weak sensitizer. Patch testing of presensitized subjects using fabrics containing tris produced responses varying with the availability of the agent at the fiber surface (10)."

In an inconclusive test, the absorption of tris from treated fabrics worn by male subjects was studied by observing the presence of the hydrolysis product of tris, 2,3-dibromopropanol, in the subjects' urine. No 2,3-dibromopropanol was detected in the urine of a man and a boy who wore tris-treated fabrics for up to 9 days (7).

In their letter to the CPSC, Hooper and Ames asserted that tris is capable of causing damage to deoxyribonucleic acid (DNA) synthesis in human cells in tissue culture. However, no conclusive data exist establishing tris as mutagenic in humans (6). Another report identifies tris(haloalkyl)phosphates as cholinesterase inhibitors and potential carcinogens and mutagens (1).

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(9) Registry of Toxic Effects of Chemical Substances 1976 Edition. Christensen, H. E., and E. J. Fairchild, eds. U.S. Department of Health, Education, and Welfare, Washington, D.C., June 1976. 1245 pp.

(10) Morrow, R. W., C. S. Hornberger, A. M. Kligman, and H. I. Miabach. Tris(2,3-dibromopropyl) Phosphate: Human Contact Sensitization, Am. Ind. Assoc. J., 37(3):1976.

POPULATION EXPOSED

A large population may be affected by production and use of fibers and polymers containing tris. At the time of the CPSC ban in April 1977, about 40% of all children's sleepwear (about 20 x 10^6 garments) in the retail industry contained tris. About 10% to 20% of these garments had already been sold to consumers. In addition, the CPSC's Bureau of Economic Analysis estimated that about 5.85 x 10^6 m^2 of tris-treated fabric was then in inventory with fabric and garment producers (6). Public exposure to other tris-treated products has not been reported.

In assessing the risk from tris-treated apparel, the CPSC considered cancer incidence projections from three studies. Hooper and Ames estimated that for 1 yr of exposure to tris-treated garments, 1.7% of the children would develop cancer (17,000 cases/million). The Environmental Defense Fund predicted incidences as high as 6,000/million male population. The CPSC's estimate ranged from 25 to 5,100 cases/million males (6).

If Velsicol Chemical and Great Lakes Chemical are indeed the only remaining manufacturers of tris, the only area affected by emissions from tris production is El Dorado, Arkansas. The city of El Dorado had a population in 1970 of about 25,000; the county encompassing El Dorado had an estimated population in 1974 of 45,000.

SECTION 5

CONTROL TECHNOLOGY

Information on actual techniques used to control emissions of tris during production is unavailable. Condensation and absorption generally appear to be the best methods for reducing atmospheric emissions from production. Incineration and flaring would produce acid contaminants, and carbon adsorption is most desirable for nonpolar compounds. Adsorbents other than carbon may have some application potential. Costs and efficiencies are dependent on the unknown characteristics of the waste stream.

Liquid wastes require a series of treatment steps. A typical sequence might include filtration, chemical precipitation and flocculation/filtration, and reverse osmosis. Biological treatment may also be applicable. Applicable technologies depend on wastewaters composition.

Control of fugitive emissions is accomplished by improving operating and maintenance procedures.

Emissions from employing tris as an additive in polymer and fiber production and from using end products containing tris can be reduced by selecting an alternate fire-retardant in place of tris.

SECTION 6

REGULATORY ACTION

On April 8, 1977, the Consumer Product Safety Commission (CPSC) banned certain children's wearing apparel and certain uncut fabric containing tris. On May 5, 1977, pursuant to an order of a Federal district court judge, the CPSC banned not only certain fabric, yarn, and fiber containing tris but tris itself which is used in or intended for use in children's wearing apparel. The CPSC is preparing an environmental impact statement of the tris ban and may be studying the appropriateness of a ban on other uses of tris (personal communication with Bob Poth of Compliance, CPSC).

REFERENCES

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